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Federal Communications Commission

In the Matter of

AMENDMENT OF PARTS 2, 22 & 25
OF THE COMMISSION'S RULESfor an Allocation of Frequencies
and Other Rules for a New
Nationwide Hybrid Space/Ground
Cellular Network for Personal/
Mobile Communications Services

92-28

JUL 21 1993
FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

RM-7927

AMENDMENT TO PETITION FOR RULE MAKING

CELSAT, Inc. ("CELSAT") hereby amends its Petition for Rule Making in the above-captioned proceeding for a shared allocation for nationwide *Hybrid Personal Communications Services* ("HPCS"). CELSAT has special strength in the fields of space satellite and spread spectrum technologies. Its vision of space/ground mobile personal communications is the newest and perhaps ultimate evolution in the merging families of personal communications services (PCS), personal communications networks (PCNs), and Mobile Satellite Services ("MSS"). CELSAT's specific HPCS system design is known as CELSTAR.

In support of this amended petition, CELSAT states as follows:

SUMMARY

A Hybrid Personal Communications Service is one offered as a fully integrated combination of space and terrestrial cellular and microcellular mobile personal communication services, operated within a relatively small amount of common spectrum under one license, and capable of both interservice and intraservice sharing. Full integration of the space and terrestrial elements means that a subscriber enjoys transparent access to the full range of personal communication services -- from within microcellular campus-like service areas to

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ubiquitous roaming anywhere in the United States -- without ever having to consciously switch between modes, and all provided through a single very low power handset.

CELSAT's original February 1992 petition for an HPCS rulemaking¹ set forth the basic HPCS system concept and identified two frequency alternatives which, at that time, seemed most appropriate. While CELSAT's Initial Petition has been tentatively denied in one limited respect, much has happened in the interim to support a change in those initial band choices and which also tends to support the shared HPCS concept.

This amendment updates CELSAT's earlier petition to propose that the Commission provide for a service allocation for shared hybrid personal communications services. Specifically, CELSAT requests an allocation by rule change of one particular band pair in the Emerging Technologies ("ET") segments at 1970-1990 MHz up and 2160-2180 MHz down (the "ET Space Band").

At present these bands are heavily occupied by private and common carrier fixed microwave services. The HPCS concept, however, offers the greatest mobile and personal service opportunity yet to co-exist with incumbents on an interservice shared basis. It is this superior capability, along with its numerous service benefits, which make HPCS the preferred candidate for an allocation in the ET Space Bands.

HPCS is not just a new service; it is a new concept in managing the scarce spectrum efficiently, and with flexibility and adaptability for both present and future services and applications. HPCS' unique sharing capabilities are grounded in an operational protocol that will support viable initial HPCS interservice operation on a shared, not-to-interfere and not-to-claim-interference basis requiring as little as 10% initial negotiated spectral relocation of fixed service incumbents.

Once the proposed band is largely cleared the HPCS concept will further support coexisting competitive systems on the basis of intrasevice full

¹ Petition for Amendment of Parts 2, 22, & 25 of the Commission's Rules, RM-7927, CELSAT Inc., February 6, 1992.

band interference sharing between at least two hybrids or an HPCS and an MSS system. Prudent limits on such sharing are requested, however.

The serendipitous benefits of a ubiquitous, truly integrated orchestration of space, terrestrial, and microcellular elements; all operating under common air and hardware interfaces, common spectrum and a common license; and supporting any voice, data, compressed video, or digital service up to 144 kbps, open vast new horizons in terms of functionality and national benefits, much greater than the sum of HPCS' parts. To best manage and allocate the spectrum required to support this service will likewise require integrated licensing rules and procedures beyond those that have traditionally supported merely the individual elements of HPCS (i.e., traditional cellular, land mobile, space-only MSS, and, soon, PCS). The framework for such rules are included in Appendix. Accordingly, CELSAT urges prompt consideration and adoption of the rules proposed in this Amendment to Petition for Rule Making.

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I. THE REASONS FOR THIS AMENDMENT

CELSAT's CELSTAR HPCS system is the first proposal to the FCC of a hybrid plan whereby the space and ground segments would be operated under one license using common frequencies. CELSAT's petition for rule making in the above captioned case has been pending for nearly 18 months. While the Commission has acknowledged CELSAT's filing in the context of the so-called MSS/RDSS proceeding,² the Commission has yet to act on CELSAT's generic proposal for the establishment of a *hybrid personal communications service* ("HPCS").

Since CELSAT's Initial Petition, several relevant developments now confirm that the HPCS concept is even more practical and worthwhile than initially perceived. They also provide new direction for an HPCS spectrum allocation. This amendment identifies these intervening events; it further highlights the benefits and advantages of an HPCS approach to mobile communications over both the pure or stand-alone MSS or PCS approaches; and it proposes an alternative HPCS allocation in the Emerging Technologies band.

Another purpose of this amendment is to clarify that CELSAT's approach to an integrated MSS/Cellular/PCS system (i.e., an HPCS network) will permit several forms of personal and mobile services to be offered concurrently within one common spectrum allocation. Importantly, it does not require separate allocations for each level of service. Accordingly, what CELSAT is proposing is one initial 40 MHz mixed use or hybrid allocation (a 20 MHz pair) for a new HPCS service in bands not currently being used by nor as yet being proposed for any other specific new services. As such, this is not a proposal either to "steal" spectrum from existing or proposed MSS, cellular or planned PCS systems, nor is it an attempt to bypass the allocation and licensing processes currently being developed for those as well as other highly sought after service allocations.

The contemporaneous co-use of certain subbands from within the HPCS allocation by re-assignment from space to ground for one or other type of HPCS terrestrial component will not be predetermined but will be market driven: such subchannels

- *CELSTAR/HPCS will provide important new features and functions:* In addition to conventional mobile voice and messaging, CELSTAR can provide position determination, data speeds up to 144 kbps, compressed video, and more.
- *CELSTAR/HPCS will be safe to use:* HPCS will use very low power devices (1/5th to 1/20th the power of other systems), ensuring maximum human safety. Low power consumption will also permit smaller, longer life batteries and very compact devices.
- *CELSTAR/HPCS promises greatest circuit capacity:* CELSAT's GEO satellite offers an order of magnitude more capacity than other MSC systems. as an HPCS it can further augment up to a million

The satellite component is the backbone of an HPCS system. Universal access and ubiquitous communications will be available upon launch of a single satellite and nationwide services could commence immediately after initial satellite checkout. As proposed by CELSAT, hybrid service would begin as a domestic-only offering. However, subject to the future availability of suitable (but not necessarily identical) spectrum for hybrid use throughout other World Regions, HPCS systems will eventually spread internationally.

CELSAT's three satellite configuration will offer up to 60,000 channels of voice grade (VG) or equivalent capacity deliverable from the space components alone, with thousands more channels available by replicating the cells on the ground.⁵ This enormous capacity, in turn, will permit a very low retail price per minute and a broad array of wider bandwidth functions and applications.⁶ Other hybrid configurations will be possible, achieved through different satellite orbits (e.g., LEO/MEO), smaller or greater numbers of satellites, or system designs that focus on different functionalities. CELSAT has chosen a design which optimizes capacity and available end user bandwidth, while minimizing power requirements and transmission costs. CELSAT's design average handset power will be a very safe 0.1 watt through the satellite and 20 mw over the ground.

B. HPCS' HIERARCHICAL OPERATING STRUCTURE

A hybrid system such as proposed by CELSAT will function like four wireless systems combined into one:

- (1) a nationwide mobile satellite/radio determination/messaging system (MSS/RDSS);
- (2) a metropolitan ground cellular telephone system;

⁵ Three satellites not only ensure a high level of instant-response back up, but also ensure signal diversity -- an important element for signal continuity between the satellite and a fast moving mobile unit.

⁶ CELSAT has tentatively chosen to limit commercial service offerings to up to 144 kbps (corresponding to a basic rate ISDN capacity). But technically the HPCS concept is capable of meeting the needs of even faster data rate applications.

(3) a public or proprietary microcell PCS system; and

basic CDMA modulation and multiple access protocol which will be compatible with the emerging CDMA ground cellular standard, but which will be operated in the higher Emerging Technologies 2-GHz band. The entire allocation in each direction would be subdivided into approximately fifteen 1.25-MHz CDMA subbands (assuming a 20 MHz paired allocation), and a 1.25-MHz "pilot" channel (downlink only).⁹ Every subband will have the capacity to carry a substantial number of simultaneous voice grade (VG) or equivalent communications, and will be 100% re-useable: (i) by each satellite in the CELSTAR system, and (ii) within each "space cell" or satellite beam. Any subband will be reassignable within every satellite beam for terrestrial use with virtually negligible impact on its space capacity.¹⁰

Spectrum for CELSAT's terrestrial cellular subsystems will consist of two or more 1.25-MHz CDMA subbands "split off" from the requested full hybrid allocation and re-assigned for ground use on a beam-by-beam basis. Not every satellite beam would necessarily split off subbands for ground use; different subbands could be split off in different satellite beams; and all subbands will be dynamically adaptive to changing traffic needs over the long term. To optimize spectral efficiency it is preferable that the entire band be allocated for both space and ground mobile services so that subbands can be assigned dynamically, and interchangeably, for space or ground use. It is also preferable

communications channel in one mode or the other by the network controller based on interference information and other assignment criteria. Handoffs back and forth and between space and/or ground cell subbands will occur automatically as a function of capacity, signal blockage, channel availability, threats of interference, and other criteria. All handoffs will be soft and transparent to the end user.

Expansion of a ground cellular network within each space cell or satellite beam is relatively unconstrained. Adaptive growth is possible simply

and Notice of Proposed Further Rulemaking in the PCS docket (but just shortly before the release of the text in the Emerging Technologies docket);¹³ and, of course, well before the MSS Negotiated Rulemaking. Nevertheless, in all but one respect CELSAT's pending Initial Petition and its original HPCS concept remain sound and fully intact -- technically, economically and politically. The only aspect of its plan which has been affected by these events is its choice of spectrum.

A. SPECTRUM ALLOCATIONS INITIALLY REQUESTED BY CELSAT

There is no spectrum allocation which permits both space and terrestrial mobile services to be operated under one common license in the same band, let alone on a primary basis relative to any other lesser use. Therefore CELSAT petitioned the Commission to allocate either of two possible spectrum choices specifically for such hybrid personal communications systems. Of course, the Commission has not yet done so; it has, however, issued a ruling tentatively disapproving one of CELSAT's initial selections; CELSAT's other choice appears to have been negated by WARC-92.

1. CELSAT's Original Alternative A:

CELSAT's original preference was the band pair consisting of 2110-2129 MHz and 2410-2428 MHz ("Band A"). This pair was being proposed for generic mobile satellite services by the U.S. delegation to the WARC-92 conference. However, its recommendation was not adopted at WARC-92. Thus, it is probably no longer a viable choice for HPCS.

2. Alternative B: RDSS L/S Bands

CELSAT's second choice was the so-called RDSS spectrum at 1610-1626.5 MHz and 2483.5-2500 MHz ("Band B"). However, this band pair was already being sought by AMSC and the Big LEO applicants, each of which claimed at the time that

¹³ Notice of Proposed Rule Making, ET Docket No. 92-9, Adopted January 16, 1992, 7 FCC Rcd 1542 (1992).

CELSAT was not eligible as a potential applicant in this band because an application cut-off had already taken effect.¹⁴ The Commission dismissed CELSAT's petition as to these bands, but for other reasons.

B. THE COMMISSION'S MSS TENTATIVE DECISION

In its *Notice of Proposed Rule Making and Tentative Decision*¹⁵ in the so-called "Big LEO" proceeding the Commission tentatively allocated the 1610-1626.5 MHz and 2483.5-2500 MHz bands exclusively for mobile satellite and RDSS services. The Commission sought further comment on its initial allocation and, based in part on the response, it also instituted a negotiated rulemaking¹⁶ to permit the MSS industry proponents one additional opportunity to devise a method by which these bands could be shared effectively among multiple MSS systems, particularly those proposed by the six pending MSS LEO applications.¹⁷ Further, the Commission tentatively denied a pioneer's preference to all the pending LEO applicants. It did not, however, dismiss CELSAT's pioneer's preference request (which is still pending).¹⁸

In the course of arriving at its tentative conclusion the Commission took certain preliminary actions which, on the one hand, appeared to preclude

¹⁴ See, Public Notice, 6 FCC Rcd 2083 (1991).

¹⁵ In the *Matter of Amendment of Section 2.106 of the Commission's rules to Allocate the 1610-1626.5 MHz and the 2483.5-2500 MHz Bands for Use by the Mobile Satellite Service, Including Non-Geostationary Satellites*, RM-7771, RM 7773, RM 7805, RM 7806, PP-29, PP-30, PP-31, PP-32 and PP-33, *Notice of Proposed Rule Making and Tentative Decision*, ET Docket No. 92-28, released September 4, 1992 ("MSS Tentative Decision"), 7 FCC Rcd 6414.

¹⁶ See, Public Notice, CC Docket No. 92-166, DA 92-1085, released August 7, 1992, hereafter "MSS Negotiated Rulemaking."

¹⁷ CELSAT was not then, nor is it currently an "applicant" for satellite spectrum in the full legal sense. This is due, in part, to the fact that there has not been a spectrum allocation within which to file an application for a full hybrid space/ground system. In other words, CELSAT has faced a "chicken and egg" dilemma -- without a specific allocation there is no place in the spectrum to apply for a license.

¹⁸ See, CELSAT Request for Pioneer's Preference, ET File No. PP-28, filed February 10, 1992.

CELSAT from immediate consideration in the RDSS L/S Bands while, on the other, signaled encouragement for the HPCS concept -- if not in the RDSS band, then in some other band.

1. *The Partial Dismissal of CELSAT's RDSS Request*

Apparently due to CELSAT's early failure to more fully explain both its geostationary satellite characteristics and the alternative multiple operating modes of CELSAT's HPCS system, and due perhaps to the high profile of the competing LEO system applicants, the Commission tentatively dismissed CELSAT's Initial Petition in two respects:

- (i) *CELSAT's proposal for operation of a geostationary satellite in the same RDSS L/S band which the Commission thought to be more suitable only for LEO satellites; and*
- (ii) *CELSAT's proposal for a terrestrial spectrum component for its HPCS system in the same RDSS space band.¹⁹*

As to the first point, the Commission may have thought that GEO and LEO satellites are inherently incompatible. They are not.²⁰ As to the latter, the Commission based its decision on the fact that WARC-92 did not allocate the subject RDSS band for worldwide terrestrial use. CELSAT believes that it should not have mattered insofar as its hybrid use will be closely confined to within U.S. borders,²¹ and that the Commission could accommodate such limited non-conforming use either by rule change or rule waiver.

2. *CELSAT's Petition for Reconsideration*

CELSAT pointed out in its Petition for Reconsideration that LEOs and GEOs can operate together.²² Its proof lead to the recognition of this fact during the MSS Negotiated Rulemaking proceeding where it was accepted without challenge that:

"[i]n principle, both geostationary and non-geostationary satellite systems can operate in the MSS bands on an interference sharing basis provided that system parameters are chosen appropriately. No restriction on choice of orbits needs to be placed on applicants."²³

CELSAT has since further demonstrated, and the majority of the MSS system participants in the MSS Negotiated Rulemaking proceedings have agreed that CELSTAR can share effectively with any of the proposed spread spectrum CDMA LEO systems.²⁴

Until the Commission acts on CELSAT's pending Petition for Reconsideration, the *MSS Tentative Decision* appears to foreclose CELSAT from near

²² See, CELSAT Petition for Reconsideration, at p 9; CELSAT Comments, ET Docket 92-28, filed November 27, 1992 at pp. 6-8 and Appendix B "LEO and GEO Comparability".

²³ See, Report of the Above 1 GHz Negotiated Rulemaking Committee ("MSSAC Report"), Annex 1, Report of Informal Working Group 1, Attachment 1 thereto, "Final Report of the Majority of the Active Participants of Informal Working Group 1 to Above 1 GHz Negotiated rulemaking Committee" ("MSS Majority Report"), at p. 8-13, ¶8.4.4.

²⁴ Specifically, the MSS Majority Report summarily concluded, among other findings, that:

-- "There is sufficient spectrum to accommodate all of the pending applicants . . . and CELSAT";

-- "[Interference sharing] is the only approach that allows the pending applicants to share on a co-frequency, co-coverage basis with each other and permits entrance by CELSAT"; and

-- "In recognition of the substantial net increase in U.S. MSS capacity to be realized through the addition of yet another CDMA applicant such as CELSAT and the incremental public benefit which would flow therefrom, and subject to the limitations and rights of current applicants under the cutoff rules, the IWG1 Majority Report recommends that the CELSAT system receive the fair consideration to which it is entitled as a new entrant when and if it chooses to formalize the work which it has done with respect to band sharing in an FCC application." [Emphasis added.]

MSS Majority Report, *Id.*, at Summary, pp. i -iii, and Section 8.4 thereto.

term access to the RDSS band, particularly for the terrestrial component. CELSAT believes, of course, that the Commission now has good grounds for reversing its initial decision as to CELSAT's place in the MSS/RDSS band for its space component, and it still desires that the Commission act favorably on its reconsideration request. Meanwhile, in hopes of moving out of this limbo, CELSAT is submitting this revision to its Initial Petition.

3. *FCC Commitment to Consider Alternative Bands for HPSC*

The Commission was apparently sufficiently impressed with CELSAT's HPSC concept, however, to neither dismiss CELSAT's petition totally nor deny CELSAT's pioneers preference request. Instead, the Commission tentatively merely put CELSAT's request aside:

"[w]e note also that the system proposed by CELSAT would not conform to the WARC-92 allocation for the United States. In particular, the terrestrial component of its proposal is inconsistent with the international allocations. We therefore are dismissing CELSAT's proposed request for use of the RDSS frequency band as an

in 1996. This opened a new, and much more desirable option for HPCS which did not exist at the time of CELSAT's Initial Petition.

2. ET Docket 92-9/PCS Proceedings

While the concepts of "emerging technologies" and "personal communications services" were both under consideration prior to CELSAT's Initial Petition, it was only after its HPCS petition was filed that developments emerged in these proceedings relating to CELSAT's HPCS proposal.

a. ET Docket 92-9 proposed new spectrum

On February 7, 1992 (one day after CELSAT's Initial Petition), the Commission released its Notice of Proposed Rule Making in the Emerging Technologies proceeding.²⁵ Among other things, it identified 220 MHz in the 2 GHz band which it proposed to allocate for use by new technologies and/or new services. It also proposed a mechanism by which incumbent licensees might be relocated to free the spectrum for such new uses or technologies. Fortuitously, the 1970-1990 MHz and 2160-2180 MHz bands which were allocated for both ground and satellite mobile services at WARC-92 were included among those bands

issues in ET Docket 92-28, the Commission, in a first ever mention of satellite spectrum in the context of PCS, stated:

"[w]e do not intend our proposal to preclude future offerings of satellite-based PCS. We invite comment on the prospect for future satellite-based offerings for both domestic and international services, and how such offerings may be integrated into the technical and regulatory rules proposed in this proceeding."²⁶

CELSAT and other satellite proponents filed comments urging that the Commission reserve the ET tentative spectrum allocations at 1970-1990 MHz and 2160-2180 MHz for mobile satellite purposes and not allocate any of this spectrum for conventional PCS use. CELSAT, however, was the only truly responsive party to highlight the role of satellites in promoting PCS as part of a space/ground hybrid personal communications service ("HPCS").²⁷

Briefly, CELSAT made the following points in the PCS proceeding:

-- Urged the Commission to allocate the spectrum at 1970-1990 MHz and 2160-2180 MHz for *hybrid personal communications services*;

-- Recommended, in the alternative, that the FCC allocate the 1975-1990 portion for HPCS use on a primary basis, and the 1970-1975 MHz portion of the lower band for such use on a secondary basis if, in fact, the Commission chooses to include these latter frequencies among the allocation for a third, "C" group PCS spectrum allocation;

-- Pointed out that the 1970-1990 MHz and 2160-2180 MHz bands are the only bands in the emerging technologies proposal which provide under WARC-92 for both mobile satellite and ground mobile

-- Showed how the HPCS licensing structure would accommodate a diversity of ownership interests, including substantial minority opportunity.

3. **FCC MSS Negotiated Rulemaking and its Failure to Reach Consensus on Sharing**

The most recent development bearing on this amendment is the disappointing outcome of the MSS Negotiated Rulemaking.²⁸ While that effort was enormous, and while its technical output will prove useful to both the Commission



are concerned, CELSAT is concerned that these same parties will use every legal means to keep CELSAT from participating in the RDSS L/S-Band, notwithstanding their recent unambiguous acknowledgments of CELSAT's deserving place in this

There are two main disadvantages, however:

- a. In order for the various coverage regions or "cells" to be "sufficiently separated" it often requires further band segmentation by frequency or time slots within a given provider's allocation so that adjacent cells do not reuse the same frequency subbands at the same time. This commonly results in a "cluster" size "n" of 7 to 13 cells, and reduction of the usable bandwidth in each cell by a corresponding factor. The effect of this is to reduce the potential capacity of the system by a factor equal to the cluster size.
- b. Sharing between independent providers is constrained for all practical purposes to the fixed, unadaptable fractions of bands provided for in the allocations. Thus, if on a dynamic basis, one provider sometimes overshoots its capacity projections and needs more spectrum while another has spectrum lying fallow, there is no simple technical means whereby the first provider can make any use of the latter's unused spectrum.

To overcome these traditional disadvantages the participants sponsoring the MSS Majority Report, including CELSAT, offered contemporary system proposals based upon "Interference Sharing" through band-spread (CDMA) waveforms. The advantage gained is that the above two listed handicaps of band segmentation no longer pertain. The full bandwidth may be reused in every cell, and flexible dynamic sharing between intraservice providers is inherent and automatic.³³ Generally, in the view of CELSAT and the majority of MSS proponent/participants, the more contemporary approach is preferred, and results in a significantly larger total capacity for the CDMA or interference sharing approach while permitting competition rather than inviting a monopoly.

2. *Sharing Laws Developed*

During the course of the proceedings the methodology for calculating the individual and aggregate MSS system capacities in the presence of mutual interference sharing, and the controls necessary to insure equitable sharing, both as put forth originally by CELSAT (MSSAC/IWG1-5, -6, MSS Majority Report)

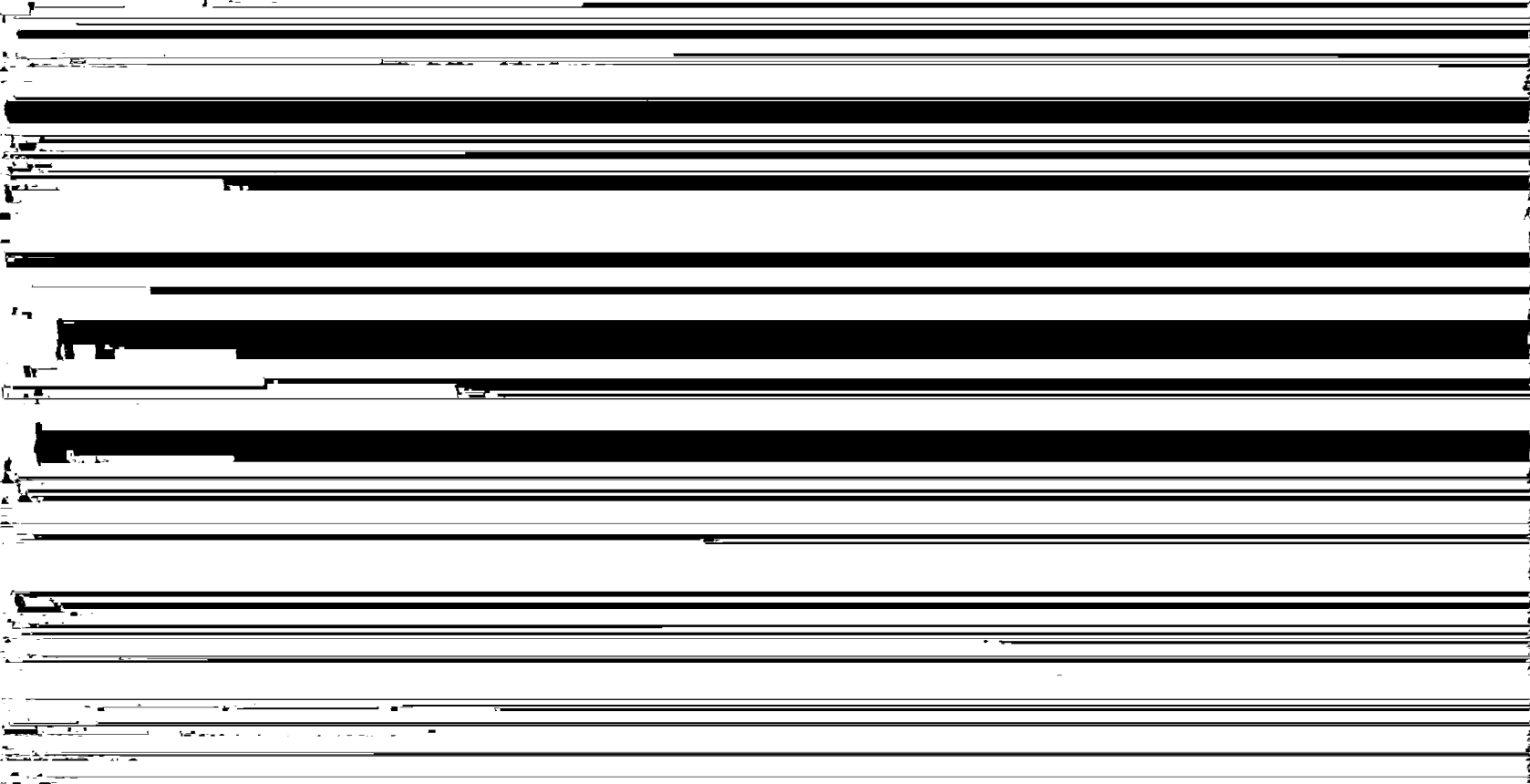
³³ The sole disadvantage of the spread spectrum approach, however, is a tolerable one from a public policy standpoint consisting of the fact that, for a single user, its capacity is reduced relative to an exclusive band allocation by the increase in co-channel interference from other users.

were endorsed and adopted by the MSS majority participants.³⁴ In effect, the parties finally verified what they had been urging before the Commission all along, but had until then failed to prove convincingly even to themselves, let alone to others. The concept of default control values for the necessary sharing control parameters, as well as the working default values themselves were also accepted (again essentially as originally put forth by CELSAT (MSSAC/IWG1-68 and MSS Majority Report, Annex 2.1)), thereby ensuring that the sharing concept could be made to work in practice as well as in theory.

These were milestone industry accomplishments which should not go unrecognized and unrewarded; one way or another, the Commission needs urgently to advance these important contemporary concepts as a matter of public policy and in operational reality.

3. *LEO-GEO Compatibility*

Initial concerns about GEO vs. LEO band sharing incompatibility were fully resolved in the MSS Negotiated Rulemaking process. CELSAT's contributions (MSSAC/IWG1-68 and MSS Majority Report, Annex 5.1) demonstrated that the key to equitable sharing between diverse satellite systems is simply that each system must be subject to the same PFD and Area Aggregate EIRP density limits, ρ and ϵ



4. *Current MSS LEO Systems Fall Short of Optimum*

The MSS Negotiated Rulemaking proceedings afforded an unusual opportunity to compare first hand the relative merits of LEO vs GEO systems for MSS service. Historically, AMSC proposed the first fully developed MSS satellite system, a geostationary orbit system. However, as a result of a combination of other design factors, the subscriber unit is necessarily fairly large, high-